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Appendix II

Electrical Power System Device Numbers and Functions

The devices in switching equipment are referred to by numbers, with appropriate suffix letters when necessary, according to the functions they perform.

These numbers are based on a system adopted as standard for automatic switchgear by IEEE, and incorporated in American Standard C37.2-1970. This system is used in connection diagrams, in instruction books, and in specifications.

Device Number	Definition and Function
1	**Master Element** is the initiating device, such as a control switch, voltage relay, float switch, etc., which serves either directly, or through such permissive devices as protective and time-delay relays to place an equipment in or out of operation.
2	**Time-delay starting, or closing relay** is a device which functions to give a desired amount of time delay before or after any point of operation in a switching sequence or protective relay system, except as specifically provided by device functions 48, 62, and 79 described later.
3	**Checking or interlocking relay** is a device which operates in response to the position of a number of other devices, (or to a number of predetermined conditions), in an equipment, to allow an operating sequence to proceed, to stop, or to provide a check of the position of these devices or of these conditions for any purpose.
4	**Master contactor** is a device, generally controlled by device No. 1 or equivalent, and the required permissive and protective devices, that serves to make and break the necessary control circuits to place an equipment into operation under the desired conditions and to take it out of operation under other or abnormal conditions.
5	**Stopping device** is a control device used primarily to shut down an equipment and hold it out of operation. [This device may be manually or electrically actuated, but excludes the function of electrical lockout (see device function 86) on abnormal conditions.]
6	**Starting circuit breaker** is a device whose principal function is to connect a machine to its source of starting voltage.
7	**Anode circuit breaker** is one used in the anode circuits of a power rectifier for the primary purpose of interrupting the rectifier circuit if an arc back should occur.
8	**Control power disconnecting device** is a disconnective device – such as a knife switch, circuit breaker or pullout fuse block, used for the purpose of connecting and disconnecting the source of control power to and from the control bus or equipment. **Note:** Control power is considered to include auxiliary power which supplies such apparatus as small motors and heaters.
9	**Reversing device** is used for the purpose of reversing a machine field or for performing any other reversing functions.
10	**Unit sequence switch** is used to change the sequence in which units may be placed in and out of service in multiple-unit equipments.
11	Reserved for future application.
12	**Over-speed device** is usually a direct-connected speed switch which functions on machine overspeed.
13	**Synchronous-speed device**, such as a centrifugal-speed switch, a slip-frequency relay, a voltage relay, an undercurrent relay or any type of device, operates at approximately synchronous speed of a machine.
14	**Under-speed device** functions when the speed of a machine falls below a predetermined value.
15	**Speed or frequency, matching device** functions to match and hold the speed or the frequency of a machine or of a system equal to, or approximately equal to, that of another machine, source or system.
16	Reserved for future application.
17	**Shunting or discharge switch** serves to open or to close a shunting circuit around any piece of apparatus (except a resistor), such as a machine field, a machine armature, a capacitor or a reactor.

Device Number	Definition and Function
	Note: This excludes devices which perform such shunting operations as may be necessary in the process of starting a machine by devices 6 or 42, or their equivalent, and also excludes device 73 function which serves for the switching of resistors.
18	**Accelerating or decelerating device** is used to close or to cause the closing of circuits which are used to increase or to decrease the speed of a machine.
19	**Starting-to-running transition contactor** is a device which operates to initiate or cause the automatic transfer of a machine from the starting to the running power connection.
20	**Electrically operated valve** is an electrically operated, controlled or monitored valve in a fluid line.
	Note: The function of the valve may be indicated by the use of the suffixes.
21	**Distance relay** is a device which functions when the circuit admittance, impedance or reactance increases or decreases beyond predetermined limits.
22	**Equalizer circuit breaker** is a breaker which serves to control or to make and break the equalizer or the current-balancing connections for a machine field, or for regulating equipment, in a multiple-unit installation.
23	**Temperature control device** functions to raise or lower the temperature of a machine or other apparatus, or of any medium, when its temperature falls below, or rises above, a predetermined value.
	Note: An example is a thermostat which switches on a space heater in a switchgear assembly when the temperature falls to a desired value as distinguished from a device which is used to provide automatic temperature regulation between close limits and would be designated as 90T.
24	Reserved for future application.
25	**Synchronizing or synchronism-check device** operates when two ac circuits are within the desired limits of frequency, phase angle or voltage, to permit or to cause the paralleling of these two circuits.
26	**Apparatus thermal device** functions when the temperature of the shunt field or the armortisseur winding of a machine, or that of a load limiting or load shifting resistor or of a liquid or other medium exceeds a predetermined value; or if the temperature of the protected apparatus, such as a power rectifier, or of any medium decreases below a predetermined value.
27	**Undervoltage relay** is a device which functions on a given value of undervoltage.
28	**Flame detector** is a device that monitors the presence of the pilot or main flame in such apparatus as a gas turbine or a steam boiler.
29	**Isolating contactor** is used expressly for disconnecting one circuit from another for the purposes of emergency operation, maintenance, or test.
30	**Annunciator relay** is a nonautomatically reset device that gives a number of separate visual indications upon the functioning of protective devices, and which may also be arranged to perform a lockout function.
31	**Separate excitation device** connects a circuit such as the shunt field of a synchronous converter, to a source of separate excitation during the starting sequence; or one which energizes the excitation and ignition circuits of a power rectifier.
32	**Directional power relay** is one which functions on a desired value of power flow in a given direction, or upon reverse power resulting from arc back in the anode or cathode circuits of a power rectifier.
33	**Position switch** makes or breaks contact when the main device or piece of apparatus, which has no device function number, reaches a given position.
34	**Master sequence device** is a device such as a motor-operated multi-contact switch, or the equivalent, or a programming device, such as a computer, that establishes or determines the operating sequence of the major devices in an equipment during starting and stopping or during other sequential switching operations.
35	**Brush-operating, or slip-ring-short-circuiting, device** is used for raising, lowering, or shifting the brushes of a machine, or for short-circuiting its slip rings, or for engaging or disengaging the contacts of a mechanical rectifier.

Device Number	Definition and Function
36	**Polarity or polarizing voltage device** operates or permits the operation of another device on a predetermined polarity only or verifies the presence of a polarizing voltage in an equipment.
37	**Undercurrent or underpower relay** functions when the current or power flow decreases below a predetermined value.
38	**Bearing protective device** functions on excessive bearing temperature, or on other abnormal mechanical conditions, such as undue wear, which may eventually result in excessive bearing temperature.
39	**Mechanical condition monitor** is a device that functions upon the occurrence of an abnormal mechanical condition (except that associated with bearings as covered under device function 38), such as excessive vibration, eccentricity, expansion, shock, tilting, or seal failure.
40	**Field relay** functions on a given or abnormally low value or failure of machine field current, or on an excessive value of the reactive component of armature current in an ac machine indicating abnormally low field excitation.
41	**Field circuit breaker** is a device which functions to apply, or to remove, the field excitation of a machine.
42	**Running circuit breaker** is a device whose principal function is to connect a machine to its source of running or operating voltage. This function may also be used for a device, such as a contactor, that is used in series with a circuit breaker or other fault protecting means, primarily for frequent opening and closing of the circuit.
43	**Manual transfer or selector device** transfers the control circuits so as to modify the plan of operation of the switching equipment or of some of the devices.
44	**Unit sequence starting relay** is a device which functions to start the next available unit in a multiple-unit equipment on the failure or on the non-availability of the normally preceding unit.
45	**Atmospheric condition monitor** is a device that functions upon the occurrence of an abnormal atmospheric condition, such as damaging fumes, explosive mixtures, smoke, or fire.
46	**Reverse-phase, or phase-balance, current relay** is a relay which functions when the polyphase currents are of reverse-phase sequence, or when the polyphase currents are unbalanced or contain negative phase-sequence components above a given amount.
47	**Phase-sequence voltage relay** functions upon a predetermined value of polyphase voltage in the desired phase sequence.
48	**Incomplete sequence relay** is a relay that generally returns the equipment to the normal, or off, position and locks it out if the normal starting, operating or stopping sequence is not properly completed within a predetermined time. If the device is used for alarm purposes only, it should preferably be designated as 48A (alarm).
49	**Machine, or transformer, thermal relay** is a relay that functions when the temperature of a machine armature, or other load carrying winding or element of a machine, or the temperature of a power rectifier or power transformer (including a power rectifier transformer) exceeds a predetermined value.
50	**Instantaneous overcurrent, or rate-of-rise relay** is a relay that functions instantaneously on an excessive value of current, or on an excessive rate of current rise, thus indicating a fault in the apparatus or circuit being protected.
51	**Ac time overcurrent relay** is a relay with either a definite or inverse time characteristic that functions when the current in an ac circuit exceeds a predetermined value.
52	**Ac circuit breaker** is a device that is used to close and interrupt an ac power circuit under normal conditions or to interrupt this circuit under fault or emergency conditions.
53	**Exciter or dc generator relay** is a relay that forces the dc machine field excitation to build up during starting or which functions when the machine voltage has built up to a given value.
54	Reserved for future application.
55	**Power factor relay** is a relay that operates when the power factor in an ac circuit rises above or below a predetermined value.
56	**Field application relay** is a relay that automatically controls the application of the field excitation to

Device Number	Definition and Function
	an ac motor at some predetermined point in the slip cycle.
57	**Short-circuiting or grounding device** is a primary circuit switching device that functions to short-circuit or to ground a circuit in response to automatic or manual means.
58	**Rectification failure relay** is a device that functions if one or more anodes of a power rectifier fail to fire, or to detect an arc-back or on failure of a diode to conduct or block properly.
59	**Overvoltage relay** is a relay that functions on a given value of overvoltage.
60	**Voltage or Current balance relay** is a relay that operates on a given difference in voltage, or current input or output of two circuits.
61	Reserved for future application.
62	**Time-delay stopping or opening relay** is a time-delay relay that serves in conjunction with the device that initiates the shutdown, stopping, or opening operation in an automatic sequence.
63	**Pressure switch** is a switch which operates on given values or on a given rate of change of pressure.
64	**Ground protective relay** is a relay that functions on failure of the insulation of a machine, transformer or of other apparatus to ground, or on flashover of a dc machine to ground. Note: This function is assigned only to a relay which detects the flow of current from the frame of a machine or enclosing case or structure of a piece of apparatus to ground, or detects a ground on a normally ungrounded winding or circuit. It is not applied to a device connected in the secondary circuit or secondary neutral of a current transformer, or in the secondary neutral of current transformer, connected in the power circuit of a normally grounded system.
65	**Governor** is the assembly of fluid, electrical, or mechanical control equipment used for regulating the flow of water, steam, or other medium to the prime mover for such purposes as starting, holding speed or load, or stopping.
66	**Notching or jogging device** functions to allow only a specified number of operations of a given device, or equipment, or a specified number of successive operations within a given time of each other. It also functions to energize a circuit periodically or for fractions of specified time intervals, or that is used to permit intermittent acceleration or jogging of a machine at low speeds for mechanical positioning.
67	**Ac directional overcurrent relay** is a relay that functions on a desired value of ac overcurrent flowing in a predetermined direction.
68	**Blocking relay** is a relay that initiates a pilot signal for blocking of tripping on external faults in a transmission line or in other apparatus under predetermined conditions, or cooperates with other devices to block tripping or to block reclosing on an out-of-step condition or on power swings.
69	**Permissive control device** is generally a two-position, manually operated switch that in one position permits the closing of a circuit breaker, or the placing of an equipment into operation, and in the other position prevents the circuit breaker or the equipment from being operated.
70	**Rheostat** is a variable resistance device used in an electric circuit, which is electrically operated or has other electrical accessories, such as auxiliary, position, or limit switches.
71	**Level switch** is a switch which operates on given values, or on a given rate of change, of level.
72	**Dc circuit breaker** is used to close and interrupt a dc power circuit under normal conditions or to interrupt this circuit under fault or emergency conditions.
73	**Load-resistor contactor** is used to shunt or insert a step of load limiting, shifting, or indicating resistance in a power circuit, or to switch a space heater in circuit, or to switch a light, or regenerative load resistor of a power rectifier or other machine in and out of circuit.
74	**Alarm relay** is a device other than an annunciator, as covered under device No. 30, which is used to operate, or to operate in connection with, a visual or audible alarm.
75	**Position changing mechanism** is a mechanism that is used for moving a main device from one

Device Number	Definition and Function
	position to another in an equipment; as for example, shifting a removable circuit breaker unit to and from the connected, disconnected, and test positions.
76	**Dc overcurrent relay** is a relay that functions when the current in a dc circuit exceeds a given value.
77	**Pulse transmitter** is used to generate and transmit pulses over a telemetering or pilot-wire circuit to the remote indicating or receiving device.
78	**Phase angle measuring, or out-of-step protective relay** is a relay that functions at a predetermined phase angle between two voltages or between two currents or between voltage and current.
79	**Ac reclosing relay** is a relay that controls the automatic reclosing and locking out of an ac circuit interrupter.
80	**Flow Switch** is a switch which operates on given values, or on a given rate of change, of flow.
81	**Frequency relay** is a relay that functions on a predetermined value of frequency – either under or over or on normal system frequency – or rate of change of frequency.
82	**Dc reclosing relay** is a relay that controls the automatic closing and reclosing of a dc circuit interrupter, generally in response to load circuit conditions.
83	**Automatic selective control or transfer relay** is a relay that operates to select automatically between certain sources or conditions in an equipment, or performs a transfer operation automatically.
84	**Operating mechanism** is the complete electrical mechanism or servo-mechanism, including the operating motor, solenoids, position switches, etc., for a tap changer, induction regulator or any similar piece of apparatus which has no device function number.
85	**Carrier or pilot-wire receiver relay** is a relay that is operated or restrained by a signal used in connection with carrier-current or dc pilot-wire fault directional relaying.
86	**Locking-out relay** is an electrically operated, hand or electrically reset, relay that functions to shut down and hold an equipment out of service on the occurrence of abnormal conditions.
87	**Differential protective relay** is a protective relay that functions on a percentage or phase angle or other quantitative difference of two currents or of some other electrical quantities.
88	**Auxiliary motor or motor generator** is one used for operating auxiliary equipment such as pumps, blowers, exciters, rotating magnetic amplifiers, etc.
89	**Line switch** is used as a disconnecting load-interrupter, or isolating switch in an ac or dc power circuit, when this device is electrically operated or has electrical accessories, such as an auxiliary switch, magnetic lock, etc.
90	**Regulating device** functions to regulate a quantity, or quantities, such as voltage, current, power, speed, frequency, temperature, and load, at a certain value or between certain (generally close) limits for machines, tie lines or other apparatus.
91	**Voltage directional relay** is a relay that operates when the voltage across an open circuit breaker or contactor exceeds a given value in a given direction.
92	**Voltage and power directional relay** is a relay that permits or causes the connection of two circuits when the voltage difference between them exceeds a given value in a predetermined direction and causes these two circuits to be disconnected from each other when the power flowing between them exceeds a given value in the opposite direction.
93	**Field changing contactor** functions to increase or decrease in one step the value of field excitation on a machine.
94	**Tripping or trip-free relay** functions to trip a circuit breaker, contactor, or equipment, or to permit immediate tripping by other devices; or to prevent immediate reclosure of a circuit interrupter, in case it should open automatically even though its closing circuit is maintained closed.
95 96 97	Used only for specific applications on individual installations where none of the assigned numbered functions from 1 to 94 is suitable.

Devices Performing More Than One Function
If one device performs two relatively important functions in an equipment so that it is desirable to identify both of these functions, this may be done by using a double function number and name such as:

50/51 Instantaneous and Time Overcurrent Relay.

Suffix Numbers
If two or more devices with the same function number and suffix letter (if used) are present in the same equipment, they may be distinguished by numbered suffixes as for example, 52X-1 52X-2 and 52X-3, when necessary.

Suffix Letters
Suffix letters are used with device function numbers for various purposes. In order to prevent possible conflict each suffix letter should have only one meaning in an individual equipment. All other words should use the abbreviations as contained in ANSI Y1.1 latest revision, or should use some other distinctive abbreviation, or be written out in full each time they are used. The meaning of each single suffix letter, or combination of letters, should be clearly designated in the legend on the drawings or publications applying to the equipment.

Lower case (small) suffix letters are used in practically all instances on electrical diagrams for the auxiliary, position, and limit switches. Capital letters are generally used for all other suffix letters.

The letters should generally form part of the device function designation, are usually written directly after the device function number, as for example, 52CS, 71W, or 49D. When it is necessary to use two types of suffix letters in connection with one function number, it is often desirable for clarity to separate them by a slanted line or dash, as for example, 20D/CS or 20D – CS.

The suffix letters which denote parts of the main device, and those which cannot or need not form part of the device function designation, are generally written directly below the device function number on drawings, as for example,

$\frac{52}{CC}$ or $\frac{43}{A}$.

Auxiliary Devices
Separate Auxiliary Devices

X
Y – Auxiliary relay①
Z
R – Raising relay
L – Lowering relay
O – Opening relay or contactor
C – Closing relay or contactor
CS – Control switch
CL – Auxiliary Relay, open (energized when main device is in open position)
OP – Auxiliary Relay, Open (energized when main device is in open position)
U – "Up" position-switch relay
D – "Down" position-switch relay
PB – Push button

① In the control of a circuit breaker with so-called X-Y relay control scheme, the X relay is the device whose main contacts are used to energize the closing coil or the device which in some other manner, such as by the release of stored energy, causes the breaker to close. The contacts of the Y relay provide the anti-pump feature for the circuit breaker.

Actuating Quantities
These letters indicate the condition or electrical quantity to which the device responds, or the medium in which it is located, such as:

A – Air, or Amperes or Alternating
C – Current
D – Direct or Discharge
E – Electrolyte
F – Frequency, or Flow or Fault
H – Explosive
J – Differential
L – Level, or Liquid
P – Power, or Pressure
PF – Power Factor
Q – Oil
S – Speed or Suction or Smoke
T – Temperature
V – Voltage, Volts, or Vacuum
VAR – Reactive Power
VB – Vibration
W – Water, or Watts

Main Devices
These letters denote the location of the main device in the circuit, or the type of circuit in which the device is used or the type of circuit or apparatus with which it is associated, when this is necessary, such as:

A – Alarm or Auxiliary Power
AN – Anode
B – Battery, or Blower, or Bus
BK – Brake
BL – Block (Valve)
BP – Bypass
BT – Bus Tie
C – Capacitor, or Condenser, Compensator, or Carrier Current or Case or Compressor
CA – Cathode
CH – Check (Valve)
D – Discharge (Valve)
E – Exciter
F – Feeder, or Field, or Filament, or Filter, or Fan

G – Generator, or Ground②
H – Heater, or Housing
L – Line or Logic
M – Motor, or Metering
N – Network, or Neutral②
P – Pump or Phase Comparison
R – Reactor, or Rectifier, or Room
S – Synchronizing or Secondary or Strainer or Sump or Suction (Valve)
T – Transformer, or Thyratron
TH – Transformer (high-voltage side)
TL – Transformer (low-voltage side)
TM – Telemeter
U – Unit

② Suffix "N" is generally used in preference to "G" for devices connected in the secondary neutral of current transformers, or in the secondary of a current transformer whose primary winding is located in the neutral of a machine or power transformer, except in the case of transmission line relaying, where the suffix "G" is more commonly used for those relays which operate on ground faults.

Main Device Parts
These letters denote parts of the main device, divided in the two following categories:

1. All parts, except auxiliary contacts, position switches, limit switches, and torque limit switches.

BK – Brake
C – Coil, or Condenser, or Capacitor
CC – Closing Coil
HC – Holding Coil
M – Operating Motor
MF – Fly-Ball Motor
ML – Load-limit Motor
MS – Speed adjusting, or Synchronizing, Motor
S – Solenoid
SI – Seal-in
TC – Trip Coil
V – Valve

2. All auxiliary contacts and position and limit switches for such devices and equipment as circuit breakers, contactors, valves and rheostats and contacts of relays. These are designated as follows:

a – Contact that is open when the main device is in the standard reference position, commonly referred to as the non-operated or deenergized position, and that closes when the device assumes the opposite position

b – Contact that is closed when the main device is in the standard reference position, commonly referred to as the non-operated or deenergized position, and that opens when the device assumes the opposite position

aa – Contact that is open when the operating mechanism of the main device is in the non-operated position and that closes when the operating mechanism assumes the opposite position

bb – Contact that is closed when the operating mechanism of the main device is in the non-operated position and that opens when the operating mechanism assumes the opposite position

Standard reference positions of some typical devices are as follows:

Device	Standard Reference Position
Power Circuit Breaker	Main Contacts Open
Disconnecting Switch	Main Contacts Open
Load-break Switch	Main Contacts Open
Valve	Closed Position
Gate	Closed Position
Clutch	Disengaged Position
Turning Gear	Disengaged Position
Power Electrodes	Maximum Gap Position
Rheostat	Maximum Resistance Position
Adjusting Means①	Low or Down Position
Relay②	Deenergized Position
Contactor②	Deenergized Position
Relay (latched-in type)	See 2-9.7.2 (C37.2 - 1970)
Contactor (latched-in type)	Main Contacts Open
Temperature Relay③	Lowest Temperature
Level Detector③	Lowest Level
Flow Detector③	Lowest Flow
Speed Switch③	Lowest Speed
Vibration Detector③	Minimum Vibration
Pressure Switch③	Lowest Pressure
Vacuum Switch③	Lowest Pressure, i.e., Highest Vacuum

Note: If several similar auxiliary switches are present on the same device, they should be designated numerically 1, 2, 3, etc. when necessary.

① These may be speed, voltage, current, load, or similar adjusting devices comprising rheostats, springs, levers, or other components for the purpose.
② These electrically operated devices are of the non-latched-in type, whose contact position is dependent only upon the degree of energization of the operating or restraining or holding coil or coils which may or may not be suitable for continuous energization. The deenergized position of the device is that with all coils deenergized.
③ The energizing influences for these devices are considered to be, respectively, rising temperature, rising level, increasing flow, rising speed, increasing vibration, and increasing pressure.

The simple designation "a" or "b" is used in all cases where there is no need to adjust the contacts to change position at any particular point in the travel of the main device or where the part of the travel where the contacts change position is of no significance in the control or operating scheme. Hence the "a" and "b" designations usually are sufficient for circuit breaker auxiliary switches.

Other Switches

These letters cover **all other distinguishing features or characteristics or conditions**, which serve to describe the use of the device or its contacts in the equipment such as:

A – Accelerating, or Automatic
B – Blocking, or Back-up
C – Close, or Cold
D – Decelerating, Detonate, or Down, or Disengaged
E – Emergency or Engaged
F – Failure, or Forward
H – Hot, or High
HR – Hand Reset
HS – High Speed
L – Left, or Local, or Low, or Lower, or Leading
M – Manual
OFF – Off
ON – On
P – Polarizing
R – Right, or Raise, or Reclosing, or Receiving, or Remote, or Reverse
S – Sending, or Swing
T – Test, or Trip, or Trailing
TDC – Time-delay Closing
TDO – Time-delay Opening
U – Up

Representation of Device Contacts on Electrical Diagrams

On electrical diagrams the "b" contacts of all devices, including those of relays and those with suffix letters or percentage figures, should be shown as closed contacts, and all "a" contacts should be shown as open contacts.

For those devices that have no de-energized or nonoperated position, such as manually-operated transfer or control switches (including those of the spring-return type) or auxiliary position indicating contacts on the housings or enclosures of a removable circuit breaker unit, the preferred method of representing these contacts is as an "a" switch. Each contact should, however, be identified on the elementary diagram as to when it closes.

In the case of latched-in or hand-reset locking-out relays, which operate from protective devices to perform the shutdown of an equipment and to hold it out of service, the contacts should preferably be shown in the normal non-locking-out position. In general, any devices, such as electrically-operated latched-in relays, which have no de-energized or non-operated position, and have not been specifically covered in the above paragraphs should have their contacts shown in the position most suitable for the ready understanding of the operation of the devices in the equipment, and sufficient description should be present, as necessary, on the elementary diagram to indicate the contact operation.